Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B. Tech ASE+AVE **Semester : VI**
Course Name : Digital signal processing **Time : 03 hrs**
Course Code : ELEG 311 **Max. Marks : 100**
Nos. of page(s) : 02

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected. **The Question paper has three sections: Section A, B and C, Section B and C have internal choices.**

SECTION A			
S. No.		**Marks**	**CO**
Q 1	Explain the Periodic signals and Aperiodic signals	**4**	**CO1**
Q 2	Define the Region of convergence (ROC) and properties of Z Transform	**4**	**CO2**
Q 3	What is the relation between DTFT and DFT?	**4**	**CO3**
Q 4	Draw and explain the butterfly operation in DIF FFT and DIT FFT	**4**	**CO4**
Q 5	Compare IIR and FIR digital filter?	**4**	**CO5**
SECTION B			
Q 6	Calculate 8- point DFT of the following signal $\mathbf{x(n) = \{1, 1, 1, 1\}}$ Assume imaginary part is zero. Also calculate magnitudes and phase of X(k)	**10**	**CO3**
Q 7	Compute the circular convolution of given sequence $\mathbf{X_1(n) = \{2, 1, 2, 1\}}$ $\mathbf{X_2(n) = \{1, 2, 3, 4\}}$ Using DFT and IDFT	**10**	**CO3**
Q 8	An LTI system initially at rest is characterized by a difference equation y(n) -a y(n-1) = x(n). What is the frequency response H(ω)? What is the Impulse response?	**10**	**CO1**

<table>
<tr><td>Q 9</td><td>Define the response of the FIR filter whose unit sample response is given as

$$\mathbf{h(n)} = \{ \underset{\uparrow}{\mathbf{1}}, \mathbf{2} \}$$
When input applied is, x(n) ={ $\mathbf{2}, \mathbf{1}$}. Use circular convolution and verify your result using linear convolution.
(Or)
The system function of the LTI system is given as
$$\mathbf{H(z)} = \frac{\mathbf{3-4z^{-1}}}{\mathbf{1-3.5z^{-1}+1.5z^{-2}}}$$
Specify the ROC of H(z) and determine unit sample response h(n) for following condition: a) Sample system b) Causal system c) Anti-causal system</td><td>10</td><td>CO2</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>Obtain the 8-point DFT of the following sequence using Radix-2 DIF FFT Algorithms. Show the results along signal flow graph

$\mathbf{x(n)} = \{\mathbf{2}, \mathbf{1}, \mathbf{2}, \mathbf{1}\}$ Using the signal flow graph. Verify your results using direct computation of DFT</td><td>20</td><td>CO4</td></tr>
<tr><td>Q 11</td><td>Design the symmetric FIR lowpass filter whose desired frequency is given as

$$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & \text{for } |\omega| \leq \omega c \\ 0 & otherwise \end{cases}$$
The length of the filter should be 7 and $\omega c = 1$, radians/sample. Use rectangular windows.
(Or)
Design a lowpass 1 rad/sec bandwidth Chebyshev filter with the following characteristics
a) Acceptable passband ripple of 2 dB
b) Cutoff radians frequency of 1 rad/sec
c) Stopband attenuation 20dB or greater beyond 1.3 rad/sec.</td><td>20</td><td>CO5</td></tr>
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SECTION A

S. No.		Marks	CO
Q 1	Explain the Graphical representation of time shifting and time scaling properties?	**4**	**CO1**
Q 2	Differentiate between Discreate time Fourier transform (DTFT) and Z Transform?	**4**	**CO2**
Q 3	How are discreate-time signal classified?	**4**	**CO3**
Q 4	Design the second order bandpass Chebyshev filter with the passband of 200 Hz to 300 Hz	**4**	**CO5**
Q 5	Define: Hamming window in FIR Filter	**4**	**CO5**

SECTION B

Q 6	Determine the sequence x(n) whose Z Transform is given as $$X(z) = \frac{1+2z^{-1}+z^{-2}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}, \text{ ROC} : \lvert z\rvert > 1$$	**10**	**CO2**
Q 7	An FIR Filter has the impulse response of **h(n) =** $\{\mathbf{1}, \mathbf{2}, \mathbf{3}\}$**.** Determine the response of the filter to the input sequence x**(n) =** $\{\mathbf{1}, \mathbf{2}\}$**.** Use DFT and IDFT and verify using direct computation of linear convolution	**10**	**CO1**
Q 8	A difference equation of the system is given as $$y(n) - y(n-1) + \frac{1}{4}y(n-2) = x(n) + \frac{1}{4}x(n-1) - \frac{1}{4}x(n-2)$$ Determine the transfer function of the inverse system. Check whether the inverse system is causal and stable.	**10**	**CO3**

Q 9	Design an analog chebyshev filter with following specifications Passband ripple : 1 dB for $0 \leq \Omega \leq 10$ rad/sec Stopband ripple : -60dB for $\Omega \geq 50$ rad/sec (Or) Design a high pass butterworth filter of 4th order for the cutoff frequency of 50Hz	**10**	**CO5**
	SECTION-C		
Q 10	a) Define the response of the FIR filter whose unit sample response is given as $h(n) = \{ \underset{\uparrow}{1}, 2\}$ When input applied is, $x(n) = \{ 2, 1\}$. Use circular convolution and verify your result using linear convolution. b) The system function of the LTI system is given as $$H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$$ Specify the ROC of H(z) and determine unit sample response h(n) for following condition: a) Sample system b) Causal system c) Anti-causal system	**10+10** **20**	**CO2**
Q 11	Obtain the 8-point DFT of the following sequence using Radix-2 DIF FFT Algorithms. Show the results along signal flow graph $$x(n) = \{ 1, -1, -1, -1, 1, 1, 1, -1\}$$ Verify your results using direct computation of DFT (Or) Calculate the IDFT of X(k) = {0, 2.8284-j2.8284, 0,0,0,0,0, 2.8284+j2.8284} Using Inverse Radix-2 DIT-FFT Algorithms	**20**	**CO4**